cause-of-death information on death certificates cannot identify deaths from nonmaternal causes or deaths occurring 43 or more days following termination of pregnancy as associated with pregnancy, additional sources of data must be used for complete ascertainment of all pregnancy-associated deaths.

Previous studies on pregnancy-associated deaths have relied largely on linkage or records[2,6–8] or the use of a check box on the death certificate[9] to identify pregnancy-associated deaths. Only 1 study (Allen et al[10]) in New York City used death certificates, linkage of records, and review of autopsy reports to identify pregnancy-associated deaths. However, this study did not include all pregnancy-associated deaths since only records for deaths occurring within 6 months of termination of pregnancy were collected, and medical examiner records for only certain causes of death were reviewed.

This article, based on Maryland resident data for the years 1993–1998, presents more comprehensive data on pregnancy-associated deaths since it includes all deaths occurring during pregnancy or within a year of termination of pregnancy. In addition, medical examiner records for all women of reproductive age who died during the study period, regardless of cause of death, were reviewed to identify pregnancy-associated deaths.

METHODS

Data for this analysis were collected from the following 3 sources: (1) review of death certificates to identify those records on which a complication of pregnancy, childbirth, or the puerperium (ICD–9 codes 630–676) was listed as an underlying or contributing cause of death; (2) linkage of death certificates of reproductive-age women with corresponding live birth and fetal death records to identify a pregnancy within the year preceding death; and (3) review of medical examiner records for evidence of pregnancy.

Vital records data were obtained from the Vital Statistics Administration of the Maryland Department of Health and Mental Hygiene. Identification of pregnancy-associated deaths through linkage of vital records was accomplished by matching death certificates for all women of reproductive age against live birth and fetal death records to identify pregnancies occurring in the year preceding death. Successful linkage of records was achieved by matching either mother's Social Security number or mother's name and date of birth on the death record with corresponding information on live birth and fetal death records. All linked records were manually reviewed to ensure accurate matching of records.

Medical examiner records, which include autopsy reports and police records, were reviewed for all 4195 women aged 10 to 50 years whose deaths were investigated by the medical examiner during the study period. Maryland law mandates that the medical examiner investigate all deaths that occur by violence, suicide, casualty, unexpectedly, or in any suspicious or unusual manner. Death certificates were obtained for 116 women for whom medical examiner records indicated evidence of pregnancy.

With the exception of 1 death to a 14–year-old adolescent, all deaths identified through medical examiner records occurred among women who were within the traditional reproductive age group of 15 to 44 years. All deaths identified through death certificates and record linkage were among women between the ages of 15 and 44 years.

All death records that did not identify a maternal cause as the underlying cause of death (n = 184) were reviewed by trained nosologists to determine the underlying cause of death that would have been assigned if a history of pregnancy had been reported on the death certificate. Nosologists were provided with information on pregnancy outcome and, if available, the date of delivery, date of pregnancy termination, or gestational age. Revised underlying cause-of-death information was used to categorize data by cause of death.

RESULTS

A total of 247 pregnancy-associated deaths occurring between 1993 and 1998 were identified from the 3 data sources. Sixty-seven pregnancy-associated deaths (27.1%) were identified through cause-of-death information obtained from death certificates. Sixty-two of these records listed pregnancy complications as the underlying cause of death; the remaining 5 certificates listed pregnancy complications as a contributing, but not underlying, cause of death. Linkage of records identified 174 (70.4%) of all pregnancy-associated deaths and review of medical examiner records resulted in the identification of 116 (47.0%) deaths (Table 1).

TABLE 1.—NUMBER OF PREGNANCY-ASSOCIATED DEATHS BY PREGNANCY OUTCOME AND SOURCES OF DATA, MARYLAND, 1993–1998[1]

Pregnancy outcome	Total deaths	Sources of data		
		Death certificates	Record linkage	Medical examiner records
All outcomes	247	67	174	116
Live births	182	46	172	60
Fetal death	5	3	2	4
Therapeutic abortion	1	0	0	1
Undelivered	53	12	0	50
Ectopic pregnancy	7	7	0	5
Molar pregnancy	1	1	0	1
All other undelivered	45	4	0	44
Unknown	6	6	0	1

[1] Deaths from any cause during pregnancy or within 1 calendar year of delivery or termination of pregnancy, regardless of the duration or anatomical site of the pregnancy. A single death may have been ascertained from more than 1 source, therefore columns do not sum to the total number of deaths.

Sixty-five percent (n = 160) of pregnancy-associated deaths were identified through a single surveillance method. One hundred two (41.3%) were identified only through linkage of records, 45 (18.2%) only through review of medical examiner records, and 13 (5.3%) only through cause-of-death information provided on death certificates. Thirty-five percent of pregnancy-associated deaths were identified through more than 1 data source (n = 87).

One hundred eighty-two (73.7%) of the 247 pregnancy-associated deaths identified in this study followed a live birth, 5 (2.0%) followed a fetal death, 1 followed a therapeutic abortion, and 53 (21.4%) occurred among women who were pregnant at the time of death. Of the 53 deaths that occurred among pregnant women, 7 were the result of ruptured ectopic pregnancies and 1 resulted from a molar pregnancy (Table 1). Eighty-four (34.0%) deaths occurred within 42 days of delivery or termination of pregnancy, and 103 (41.7%) deaths occurred 43 to 365 days following delivery or termination of pregnancy. The time of death was unknown for 7 women (Table 2).

TABLE 2—NUMBER OF PREGNANCY-ASSOCIATED DEATHS BY CAUSE OF DEATH, SOURCE OF DATA, AND TIME OF DEATH, MARYLAND 1993–1998[1]

Cause of death	All sources				Death certificates				Record linkage				Medical examiner records			
	Total[2]	During pregnancy	After delivery of termination of pregnancy		Total[2]	During pregnancy	After delivery or termination of pregnancy		Total[2]	During Pregnancy	After delivery or termination of pregnancy		Total[2]	During Pregnancy	After delivery or termination of pregnancy	
			≤42 d	43–365 d			≤42 d	43–365 d			≤42 d	43–365 d			≤42 d	43–365 d
All causes	247	53	84	103	67	12	45	3	174	0	71	103	116	50	48	16
Homicide	50	23	3	24	0	0	0	0	27	0	3	24	25	23	1	1
Cardiovascular	48	5	21	18	13	2	6	1	36	0	18	18	30	5	15	8
Embolism	21	5	14	2	11	1	9	1	14	0	12	2	14	5	8	1
accidents[3]	18	6	2	10	0	0	0	0	11	0	1	10	9	6	2	1
Hemorrhage	17	7	9	0	16	7	8	0	5	0	5	0	10	5	5	0
Hypertensive disorders of pregnancy	16	0	15	1	14	0	13	1	16	0	15	1	10	0	9	1
Infection	16	0	7	8	4	0	3	0	15	0	7	8	3	0	2	1
Neoplasms	15	0	0	15	0	0	0	0	15	0	0	15	0	0	0	0
Substance abuse	13	1	3	9	1	0	1	0	11	0	2	9	4	1	2	1
Suicide	7	2	0	5	0	0	0	0	5	0	0	5	3	2	0	1
All other causes	26	4	10	11	8	2	5	0	19	0	8	11	8	3	4	1

[1] Deaths from any cause during pregnancy within 1 calendar year of delivery or termination pregnancy, regardless of the duration or anatomical site of the pregnancy. A single death may have been ascertained from more than 1 source, therefore columns do not sum to the total number of deaths ascertained from all sources.
[2] Totals include 7 deaths for which the time of death was unknown.
[3] Includes deaths from motor vehicle collisions, falls, drowning, and other unintentional injuries.

The leading cause of pregnancy-associated death was homicide (n=50). All homicides were identified through record linkage or review of medical examiner records rather than from death certificates, as would be expected since homicide is not a maternal cause of death. Deaths from cardiovascular disorders, the second leading cause of death (n=48), were identified through all 3 data sources, although no single source was able to identify all deaths. Of the 26 deaths from cardiovascular disorders that occurred during pregnancy or within 42 days of delivery and should therefore have been classified as maternal deaths, only 8 were identified through death certificates. A substantial proportion of deaths from other maternal causes, including embolism and infection, could not be identified from death certificates since the physicians filling out the certificates failed to report that the women were pregnant or had recent pregnancies (Table 2).

All maternal deaths, by definition, occurred during pregnancy or within 42 days of delivery or termination of pregnancy. This included most deaths from embolism, hemorrhage, and hypertensive disorders of pregnancy as well as a substantial proportion of